MICROINFINITY

User Manual Rev1.1

CruizCore® XG1010
Digital Gyroscope

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1. Introduction

The CruizCore® XG1010 is a fully self-contained MEMS digital gyroscope based on the CruizCore® R1 Series platform. Compared with the R1 Series, the XG1010 was designed with convenient packaging and communication interfaces to allow its use as a standalone sensor(see Figure 1). It provides USB and RS232 communication interfaces, the output and baud rate are adjustable for the customers' convenience. The XG1010 includes a MEMS gyroscope, internal voltage regulation, data acquisition and signal processing circuitry, communication interfaces and a RISC microprocessor running our patented error correcting algorithm. Because it uses MEMS sensors, it has the advantage of being light weight, small size and consuming low power. The XG1010 is packaged in a hard case for increasing protection against external impact. The XG1010 uses an adaptive reduced order Kalman filter to stabilized angular rates and heading angles, virtually eliminating the most common errors (i.e. bias drift, scale factor, temperature effects). The XG1010 has a 50Hz bandwidth and can precisely measure angular rates up to ± 100 deg/sec, it can also measure rates up to ± 150 deg/sec with lesser accuracy. The start-up time is less than one second, which is used to compute bias parameters; it does not require further calibration thereafter. The XG1010 is the best single axis rate measuring solution for navigation applications.

The CruizCore® XG1010 has the following features:

- Ultra low bias drift
- High resolution and accuracy
- Outstanding scale factor linearity
- Fast start-up
- Fully self-contained
- Digital output (RS232/USB)
- Low power consumption
- Low cost
- Roughed and compact package
- User friendly monitoring and testing program

Figure 1: CruizCore® XG1010.

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NOTICE: We recommend extensive testing of this product before using it in a final application. Specifically, this product should be tested in the same environmental conditions that it is intended to be used. Furthermore, we strongly recommend caution when using our product in sensitive applications that can cause injures, death or property damage due to the wrong operation of this product, which may be caused by unexpected environmental changes such as temperature, shock, excessive and continuous vibration, etc. These applications include but are not limited to:

- **Aircraft equipment**
- **Air vehicles**
- **Aerospace equipment**
- **Underwater vehicles**
- **Medical equipment**
- **Transportation equipment**
- **Disaster prevention/crime prevention equipment**
- **Applications which require especially high reliability and accuracy**

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2. Hardware Description

2.1. System Description

The CruizCore® XG1010 is compact, light, low-power consuming digital gyroscope. It uses a MEMS rate sensor. It has internal power regulation to minimize the power noises. The input voltage range of 4.75 V to 5.25 V is acceptable for power supply.

2.2. Part List Included with this Kit

The CruizCore® XG1010 is a full developer's kit intended to facilitate testing and understanding the CruizCore® R1 Series single axis gyroscope. Therefore it includes all the necessary cables and software needed for that purpose. The list of materials included with this kit is shown in Figure 2 and described in Table 1:

Figure 2: CruizCore® XG1010 part list.

Table 1: CruizCore® XG1010 part list description.

Item Number	Description
1	CruizCore® XG1010
2	USB cable
3	RS232 cable
4	CD-ROM (includes User Manual and sensor testing program)

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2.3. Cable Pin-out

For convenience, the CruizCore® XG1010 can communicate with external devices using two different interfaces: USB and RS232 ports.

2.3.1. USB Cable

The CruizCore® XG1010 USB connection is of type A (see Figure 3), the pin-out description is presented in Table 2.

Figure 3: Type A USB connector.

Table 2: USB connector type A pin-out.

Contact Number	Typical Wiring Color	Signal Name
1	Red	V_{BUS}(5V)
2	White	D-
3	Green	D+
4	Black	GND

2.3.2. RS232 Cable

The CruizCore® XG1010 provides a regular RS232 interface, that is, it already has the correct voltage levels need to communicate with a PC serial port. The cable contains six color coded terminals (see Figure 4 and Table 3).

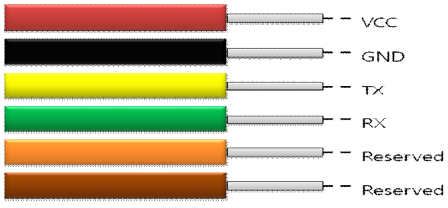

Figure 4: RS232 cable color code.

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Table 3: RS232 cable pin-out description.

Wire color	Pin description
RED	VCC
BLACK	GND
YELLOW	TX*
GREEN	RX*
ORANGE	Reserved
BROWN	Reserved

2.4. Mounting Information (Coordinate System)

The CruizCore® XG1010 coordinate system has its sensitive axis perpendicular to the device flatter area (see Figure 5), therefore the gyro will show a positive angular rate (and angle increment) when its sensitive axis is rotated in the clock-wise direction (other coordinate systems are available as an option). Incorrect mounting can produce misalignment errors that have similar effect as scale factor errors, and therefore can be treated as such. If the error is significant we recommend re-calculating the scale factor using a single-axis rate table.

2.5. Sensor Start-up

The CruizCore® XG1010 startup time is less than one second, it internally compensates for errors due to changes in temperature. However, sudden temperature changes shortly after powering-on the unit can cause static rate errors. If such temperature chances are expected, we recommend leaving the gyro stationary for about 1 second after startup.

Figure 5: CruizCore® XG1010 coordinates system.

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3. Software Description

3.1. Output Data Format

The CruizCore® XG1010 provides rate and angle outputs. The information is packed in an 8 –byte data packet, which is transmitted to external devices at the specified baud rate. For more details about the output formatting, refer to the “CruizCore® R1 Series Technical Manual”

3.2. Monitoring Program

Microinfinity Co., Ltd. provides a monitoring program. For convenience, the program displays the parsed data in numerical and graphical forms and allows saving the data for subsequent analysis. The following explanation is based on the Monitoring Program version 1.0. This program has been tested under Microsoft Windows XP SP3.

3.2.1. Installation

The monitoring program is provided in the accompanying CD. The program can be installed using the Setup.exe executable file. The installing and monitoring program requires the **.NET** framework installed in the computer.

3.2.2. Main Window

The main window (see Figure 6) displays the information related to the CruizCore® XG1010 in four different formats or windows: rate, angle, compass, and data.

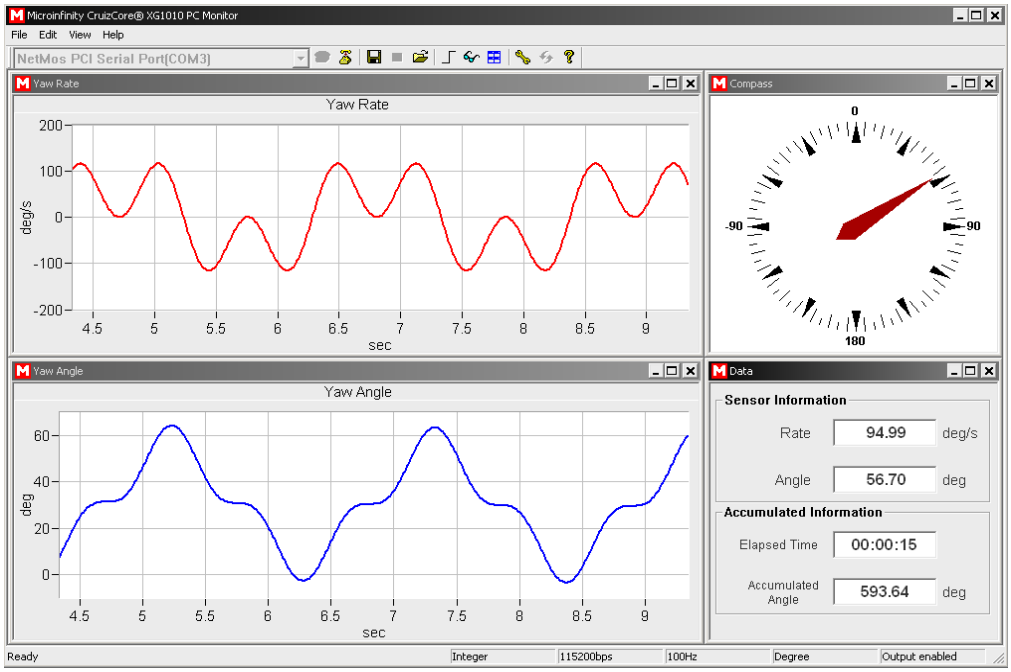

Figure 6: Program main window.

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3.2.3. Rate Window

This window shows the yaw rate of rotation data in graphic mode (see Figure 7). If the rate is larger than 150 deg/sec, the background of the plot turns red. If the rate is over 180 deg/sec (out of range), the program will make a beep sound.

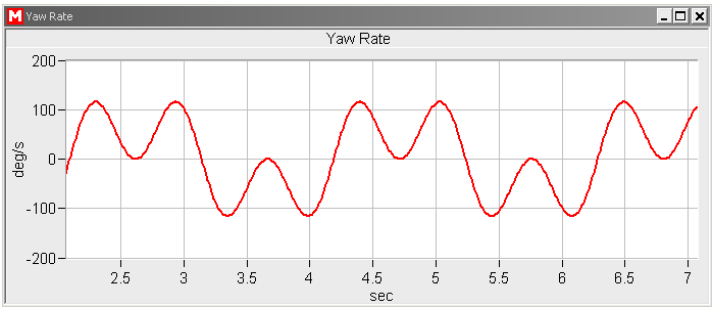

Figure 7: Rate window.

3.2.4. Angle Window

This window shows the angle or integrated rate (see Figure 8).

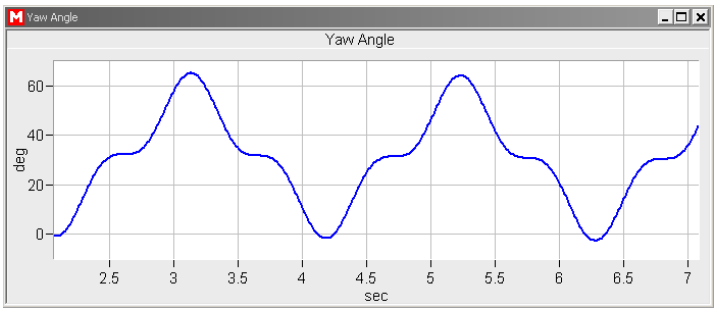

Figure 8: Angle window.

3.2.5. Compass Window

The compass window shows a simulated compass corresponding to the angle output provided by the CruizCore® XG1010 (see Figure 9). Notice that for this representation the program assumes that zero deg heading corresponds to the compass North location.

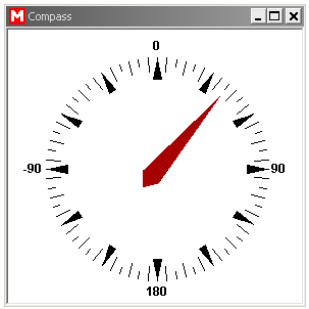

Figure 9: Compass window.

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3.2.6. Data Window

The data window shows in numerical format the parsed sensor data and accumulated heading since the sensor was reset (see Figure 10).

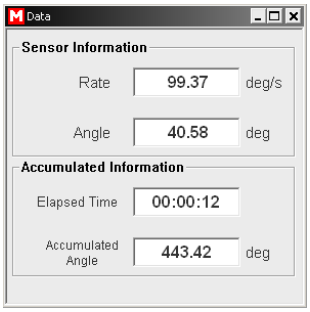
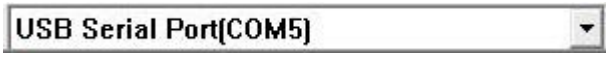


Figure 10: Data window.

3.2.7. Icon Toolbar

The icon toolbar gives access to the most important features and functions of the monitoring program. The following is a brief description of each one. Some icon can be enabled or disabled as operating mode.

COM Port selection 

Allow selecting the serial port either if it is physical port (normally COM1 and COM2) or virtual COM port as the ones created by USB-serial converters.

Connect

Serial Port Connecting.

Disconnect

Serial Port Disconnecting.

Data Save start

All the Rate and Angle data will be saved.

Output data filename is Log_ current year-month-day-hour-minute-second.out in Log folder.

Example) Log_20080503084425.out

Data Save stop

Data save will be stopped.

Data Load

Output data file will be loaded and plotted in new windows again.

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Reset

Sensor and accumulated information of CruizCore® XG1010 will be reset. After reset CruizCore® XG1010 is strongly needed in stationary state during initial alignment time.

View

Allow selecting windows that you want to show.

Window Align

All of four windows will be showed, resized and located at initial state.

Setting

Allow changing baud rate, data rate, angle format of XG1010 and whether it outputs or not. You can also store these setting information on flash memory of XG1010. The last used setting information is saved in monitoring program and the next time it will be used to connect to XG1010.

Auto baud rate detect

Allow detecting baud rate of XG1010 automatically. You can also find data rate, angle format and so on.

Help

Displays the help window, system and program information, and license information.

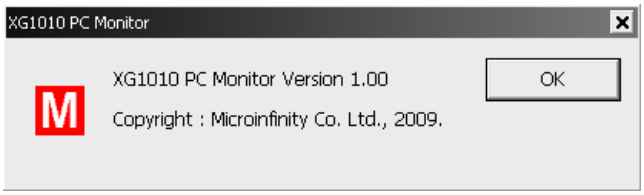

Figure 11: Help window.

3.2.8. Status Bar

Figure 12: Status Bar.

The status bar represents current setting information of PC monitor program. It is read from XG1010 when XG1010 starts or restarts. So if you want to make sure that these setting are exactly right, please use reset function to restart for XG1010. If the baud rate is different, please use auto baud rate detect function.

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3.2.9. Data Load Window

The data load window shows rate and angle data pre-stored in an output data file (see Figure 13). The following functions are available through the corresponding icons.

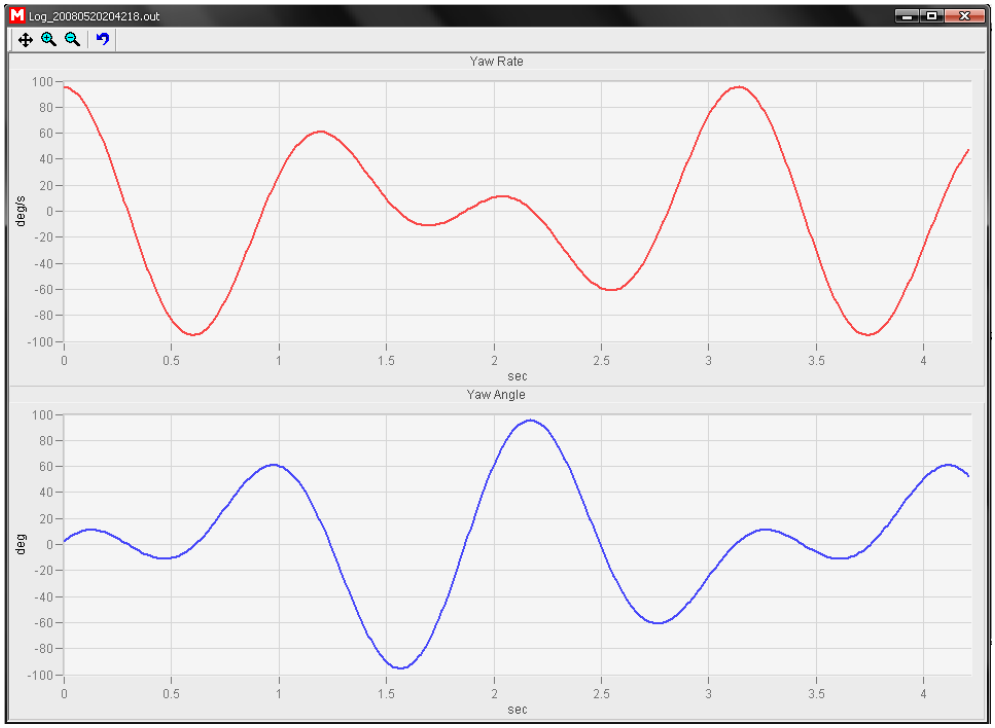

Figure 13: Data load window.

Move

Shifts the plotting area.

Zoom In

Increases the magnification of a determined plotting area.

Zoom Out

Decreases the magnification of a determined plotting area.

Reset

Re-plots the entire area using the original size and position.

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4. System Characteristics

The following tables summarize the main characteristics of the CruizCore® XG1010. These specifications subject to change without notice and several parameters can be changed under customer request as an option.

4.1. Physical Characteristics

Table 4: CruizCore® XG1010 physical characteristics.

PARAMETER	VALUE			UNIT
	Min.	Typ.	Max.	
SIZE		35.9 × 35.9 × 17.0		mm
WEIGHT		15		g

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4.2. Environmental Characteristics

Table 5: CruizCore® XG1010 environmental characteristics.

NO.	ITEMS	TEST CONDITION	TEST CRITERIA
1	High temperature storage	85°C x 120h	Refer to Table 6
2	Low temperature Storage	-40°C x 72h	Refer to Table 6
3	Temperature and Humidity cycling	25°C , 60%RH(4h) / 55°C , 95%RH(10h) /-30°C (2h) / 75°C (2h), 10cycles	Refer to Table 6
4	Thermal shock	-40°C ↔ 85°C 1hour at each temperature, 10cycles	Refer to Table 6
5	Drop	Free drop from 750mm height on a wooden board for 6 times	Refer to Table 6
6	Vibration	10Hz to 55Hz amplitude 0.75mm, 55Hz to 500Hz acceleration 98m/s2, 10Hz→500Hz→10Hz 15min/cycle, 6h(2h x 3directions)	Refer to Table 6
7	ESD	R(330Ω) C(150pF), Contact discharge, 5times	Refer to Table 6

* After each test, there should be no visible damage and the measured values shall be met Table 6.

Table 6: Judgment criteria of environment and mechanical test

ITEMS	UNITS	JUDGMENT CRITERIA
Angular error	degree	360±1.5deg. (CW rotation) 0±2.0deg. (CCW rotation)
ESD	voltage	1kV(operating), 2kV(destruct)

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4.3. Electrical Characteristics

Table 7: CruizCore® XG1010 electrical characteristics.

PARAMETER	CONDITION	VALUE			UNIT
		Min.	Typ.	Max.	
INPUT VOLTAGE	OPERATING	4.75		5.25	V
	RECOMMENDED		5		V
CURRENT	@ 5 V		10		mA
POWER	@ 5 V		50		mW

CAUTION

ESD (electrostatic discharge) sensitive device. Electrostatic charges as high as 4000 V readily accumulate on the human body and test equipment and can discharge without detection. Permanent damage may occur on devices subjected to high-energy electrostatic discharges. Therefore, proper ESD precautions are recommended to avoid performance degradation or loss of functionality.

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4.4. Performance Characteristics

Table 8: CruizCore® XG1010 performance characteristics.

PARAMETER	CONDITION	VALUE			UNIT
		Min.	Typ.	Max.	
BANDWIDTH	RATE	10		50	Hz
WARM-UP TIME	FAST WARM-UP		0.5		sec
	FULL WARM-UP[1]			5	min
ANGULAR RATE	CONTINUOUS*			± 100	deg/sec
	INSTANTANEOUS[2]			± 150	deg/sec
	RESOLUTION		0.01		deg/sec
	SCALE FACTOR ERROR		0.5	1	%
	BIAS DRIFT		< 10	50	deg/hr
DATA RATE	ADJUSTABLE[3]		100		Hz

* The system must be installed in the correct position.
1. Full warm-up: The total time that takes for full bias error calibration and temperature compensation. It is the worst case on condition that the temperature goes up suddenly without temperature compensation.
2. Prolonged time in this condition will introduce heading errors
Other data rate available as option.

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_____

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_____

3. Do you find the organization of this data sheet easy to follow? If not, why?

_____

4. What additions to the data sheet do you think would enhance the structure and subject?

_____

5. What deletions from the data sheet could be made without affecting the overall usefulness?

_____

6. Is there any incorrect or misleading information (what and where)?

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Questions:

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